

KWANTLEN UNIVERSITY COLLEGE

Department of Chemistry

CHEM 0094 FINAL EXAM

Name: _____

April 18, 2002
TIME: 3 HOURS

Instructor: _____

INSTRUCTIONS

Write your answers in the spaces provided. Rough work may be done on the backs of the pages.

Show all work for full credit.

Strict adherence to independent work.

A periodic chart is attached

Ensure this exam has 11 pages of questions

USEFUL DATA: Avogadro's number = 6.02×10^{23} /mole

$$^{\circ}\text{F} = 1.8 \times ^{\circ}\text{C} + 32$$

SOLUBILITY RULES

ION

Group IA

NH_4^+

NO_3^-

$\text{Cl}^-, \text{Br}^-, \text{I}^-$

SO_4^{2-}

S^{2-}

RULES

1. All ionic compounds in which the cation is a Group IA element or NH_4^+ are soluble.
2. All nitrates are soluble.
3. All soluble except those of Ag^+ and Pb^{2+}
4. All soluble except for CaSO_4 , BaSO_4 , SrSO_4 , PbSO_4 , and Ag_2SO_4 .
5. All sulfides are insoluble except those of the Group IA or IIA elements or NH_4^+ .
6. All other compounds are insoluble.

ACTIVITY SERIES OF THE METALS

Li K Ba Na Mg Al Zn Fe Cd Ni Sn Pb (H) Cu Hg Ag Au
Most reactive Least reactive

1. The following are properties of the element zirconium; classify them as physical or chemical properties. **[3]**
 - a) reacts with hot HCl(g) _____
 - b) melting point = 1852°C _____
 - c) reacts with silicon at high temperature _____
2. Classify the following changes as physical or chemical. **[3]**
 - a) tearing up a piece of paper _____
 - b) burning sugar _____
 - c) dissolving sugar in water _____
3. How many significant figures? **[4]**
 - a) 0.004196 _____
 - b) 2.00×10^{-3} _____
 - c) 4068 _____
 - d) 90.09 _____
4. Express the following in scientific notation to have three significant figures. **[2]**
 - a) 8,720,000
 - b) 0.006285
5.
 - a) The lowest recorded temperature in the world was recorded as -89.2°C at the Soviet Antarctic Station on July 23, 1983. What is this temperature in °F? **[2]**
 - b) The highest recorded temperature in the world was recorded as 136.4°F at Azizia, Libya, in the Sahara desert on September 13, 1922. What is this temperature in °C? **[2]**

6. Perform the following conversions.

a) 25.9 km to mm **[2]**

b) 13.6 g/mL to kg/m³ **[2]**

c) 3655 square feet to square meters (12.0 inches = 1ft, 1 inch = 2.54 cm) **[3]**

7. How many grams of gold will have the same volume as 100.0 g of copper? Densities (g/cm³) of copper and gold are 8.96 and 19.32, respectively. **[2]**

8. Much of iron is obtained from the mineral magnetite, which has a density of 5.2 g/cm³ and contains 72.4 % iron by mass. How many cubic meters of magnetite are needed to supply 1000 kg of iron? **[3]**

9. a) It takes 1368 J to raise the temperature of 45.6 g of lead by 13.3°C. What is the specific heat of lead? **[2]**

b) How much energy is needed to raise the temperature of 850 g block of aluminum from 22.8°C to 94.6°C? Specific heat of aluminum is 0.900 J/g °C. **[2]**

10. a) An ion contains 50 protons, 68 neutrons, and 48 electrons. Give its isotopic or nuclide symbol. **[1.5]**

b) How many protons , neutrons, and electrons are in $^{59}\text{Co}^{3+}$? **[1.5]**

c) Identify each of the following elements: **[6]**

i) A noble gas with 54 protons _____

ii) A member of the oxygen family. The anion with 2- charge contains 36 electrons. _____

iii) A member of the alkaline earth family. The 2+ ion has 18 electrons. _____

iv) How many elements are there in period # 4? _____

v) Write the formula of a diatomic elementary substance that is a liquid at 25°C. _____

vi) Give the symbol of the most active alkali metal. _____

- 11.** Calculate the atomic mass to four significant digits for antimony, given the following: **[3]**

Isotope	Atomic Mass(amu)	% Abundance
Sb-121	120.9038	57.25
Sb-123	122.9041	42.75

- 12.** Write the formula for each of the following: **[6]**

a) Copper(I) carbonate _____

b) Iron(II) nitrite _____

c) Diphosphorous pentoxide _____

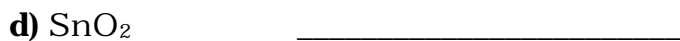
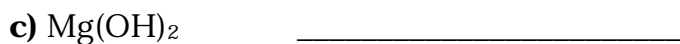
d) Hydrosulfuric acid _____

e) Cobalt (II) chloride hexahydrate _____

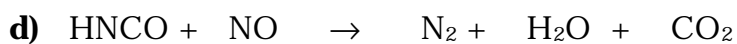
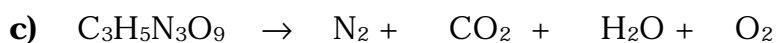
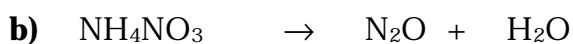
f) Ammonium sulfate _____

- 13.** Write the correct name for each of the following: **[6]**

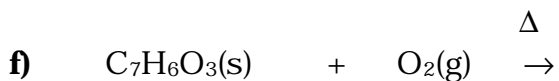
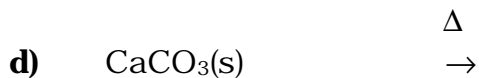
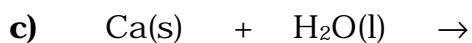
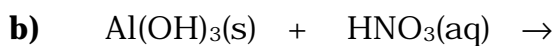
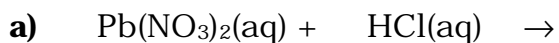
a) AgNO_3 _____



14. Balance the following equations: **[4]**



15. Complete and balance the following reactions. Give the proper states of substances. In each case there is a reaction. **[12]**



(combustion)

- 16.** Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as Nutra-Sweet. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.

a) Calculate the molar mass of aspartame. **[2]** _____

b) How many moles of molecules are in 10.0 g of aspartame? **[2]**

c) How many molecules are in 5.00 g of aspartame? **[1]**

d) How many atoms of nitrogen are in 10.0 g of aspartame? **[2]**

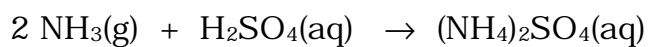
e) What is the mass of one molecule of aspartame? **[2]**

- 17.** Monosodium glutamate (MSG), a food-flavor enhancer, has been blamed for “Chinese restaurant syndrome,” the symptoms of which are headaches and chest pains. MSG has the following composition by mass: 35.51 % C, 4.77 % H, 37.85 % O, 8.29 % N, and 13.60 % Na.

a) Calculate the simplest (empirical) formula of MSG. **[5]**

b) What is its molecular formula if its molar mass is 169? **[2]**

- 18.** The fertilizer ammonium sulfate is prepared by the following reaction.



The yield of the reaction is 87.0 %. How many grams of NH_3 are needed to produce 445 grams of ammonium sulfate? **[3]**

19. Consider the reaction



If 0.86 mole of MnO_2 and 48.2 g of HCl react,

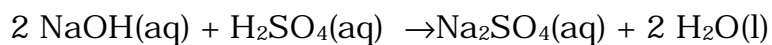
a) Which is the limiting reagent? **[4]**

b) How many grams of chlorine will be produced? **[2]**

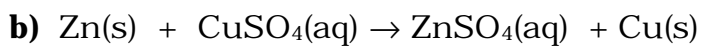
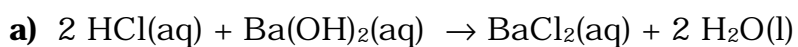
c) How many grams of which reactant are left unused? **[3]**

- 20.** Calculate the mass of NaOH required to prepare a 500.0 mL solution of concentration 2.80 M. **[2]**
- 21.** How many moles of Cl^- are present in 60.0 mL of 0.100 M MgCl_2 solution? **[2]**
- 22.** Calculate the volume in mL of a solution required to provide 0.85 g of acetic acid, CH_3COOH , from a 0.30 M solution of the acid. **[2]**
- 23.** A 46.2 mL of 0.568 M KOH solution is mixed with an 80.5 mL of 1.396 M KOH solution. The resulting solution is mixed with 228 mL of water. Calculate the molarity of KOH in the final solution. **[3]**
- 24.** An aqueous solution containing 12.0% NaOH by mass has a density of 1.131 g/mL. Calculate the molarity of NaOH in the solution. **[3]**

- 25.** How many mL of a 0.610 M NaOH solution are needed to completely neutralize 20.0 mL of a 0.245 M H₂SO₄? **[3]**



- 26.** Write the net-ionic equations for the following reactions. **[4]**



- 27.** How much heat is given off when 1.00 kg of CH₃OH is burned according to the reaction? **[2]**



